An Estimation Algorithm for Detecting and Reconstructing Optimal Maneuvers from Measurement Residuals

Completed Technology Project (2012 - 2016)

Project Introduction

This proposed research addresses the problem of optimal maneuver detection and reconstruction with regards to an astrodynamics application. Maneuver detection and reconstruction are processes by which an independent observer may determine when and how a body is moving in a dynamical system under the influence of unmodeled active control. This research shall specifically address the problem of how one can determine and reconstruct orbital maneuvers assuming they are performed optimally with respect to fuel expenditure. This assumption is valid due to limited availability of fuel for space-based missions and how important fuel is to a successful mission. The inevitable goal of this research is produce an estimation algorithm that accounts for the influences of unmodeled optimal control. Essentially, this research is uniting the fields of estimation and optimal control in an algorithm that is applicable to various disciplines. Algorithm development will involve merging current research in maneuver detection with lessons from various fields of study including astrodynamics, estimation, optimal control, information fusion, and Space Situational Awareness. The work will primarily be simulation-based, and actual mission data would likely be used to help quantify the algorithms accuracy. Initial work will start by investigating linear estimator algorithms, but eventually the work will be pushed to higher order, non-Gaussian filters. Understanding the dynamics of Earths orbital environment is of paramount concern. With the increase in orbital debris from recent collisions, and the increase in launch activity this environment is becoming increasingly crowded. Overcrowding in this environment increases the hazards associated with it due to increased potential for collisions. By gaining a better understanding of the dynamics (both natural and active) associated with this environment we can better pinpoint these potential hazards. Algorithms such as the one proposed in this paper help reduce the hazards associated with space-based missions, which is imperative to ensuring continued access to Earth-orbit and beyond.

Anticipated Benefits

Understanding the dynamics of Earths orbital environment is of paramount concern. With the increase in orbital debris from recent collisions, and the increase in launch activity this environment is becoming increasingly crowded. Overcrowding in this environment increases the hazards associated with it due to increased potential for collisions. By gaining a better understanding of the dynamics (both natural and active) associated with this environment we can better pinpoint these potential hazards. Algorithms such as the one proposed in this paper help reduce the hazards associated with space-based missions, which is imperative to ensuring continued access to Earth-orbit and beyond.

Project Image An Estimation Algorithm for Detecting and Reconstructing Optimal Maneuvers from Measurement Residuals

Table of Contents

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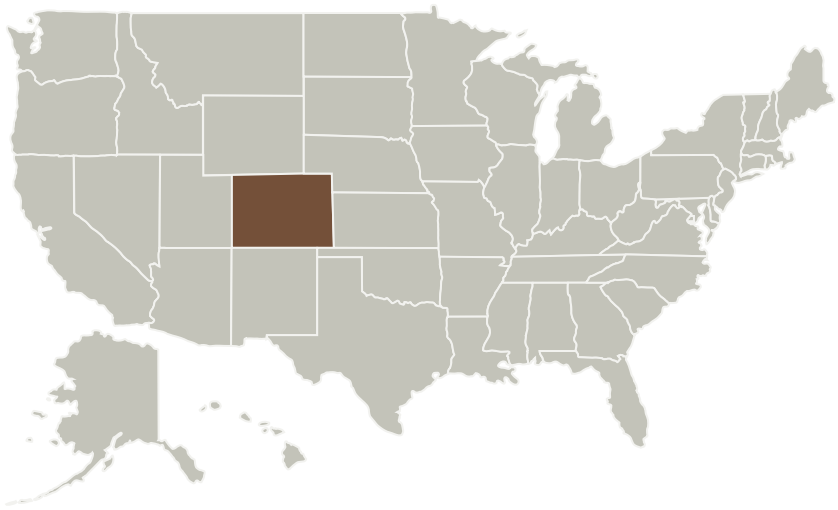
Completed Technology Project (2012 - 2016)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Colorado Boulder	Supporting Organization	Academia	Boulder, Colorado

Primary U.S. Work Locations
Colorado

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

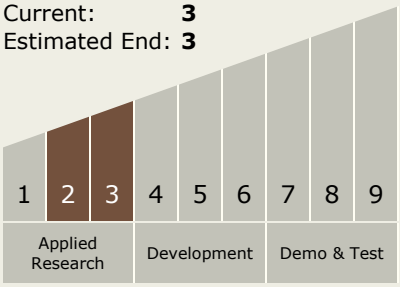
Daniel Scheeres

Co-Investigator:

Daniel Lubey

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Images

11522-1363113964079.jpg
Project Image An Estimation Algorithm for Detecting and Reconstructing Optimal Maneuvers from Measurement Residuals
(https://techport.nasa.gov/image/1716)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.2 Flight Mechanics
    - TX15.2.1 Trajectory Design and Analysis